Climate Change through a Gender Lens: Knowledge Gaps and Adaptive Capacities in Sub-Saharan Africa

***Never Assan[1], Mgcini Moyo[2]**

[1]Zimbabwe Open University, Faculty of Agriculture, Department of Agriculture Management, Bulawayo Regional Campus, Bulawayo, Zimbabwe

[2]Faculty of Humanities and Social Sciences, Department of Educational Foundations, Lupane State University, Lupane, Zimbabwe

***Corresponding Author**

DOI: https://dx.doi.org/10.47772/IJRISS.2025.908000329

Received: 16 July 2025; Accepted: 25 July 2025; Published: 09 September 2025

ABSTRACT

In Sub-Saharan Africa, gender serves as a critical perspective in understanding climate change adaptation. The region's climate dynamics highlight inequalities, where gender roles and resource disparities influence exposure to risk and resilience. In many developing areas, both women and men face challenges related to capacity, resources, and knowledge, which strain agricultural systems, biodiversity, and ecosystem sustainability. These gender disparities are interconnected with socio-economic status, political marginalization, and unequal access to land and natural resources. As the climate crisis intensifies, the most at-risk and marginalized populations are disproportionately affected, emphasizing the need for inclusive, context-specific adaptation strategies. Climate-induced disasters expose gender-specific risk factors, revealing gaps in preparedness and response frameworks. Structural (i.e., referring to institutional, legal, and cultural systems that perpetuate inequality) inequalities demonstrate how men and women experience and respond to climate impacts differently, underscoring the importance of integrating gender considerations into adaptation planning. When gender is incorporated into climate strategies, communities are better equipped to manage risk, enhance food security, and promote the sustainable use of natural resources. Localized approaches, such as conservation agriculture, agroforestry, forest stewardship, biogas systems, and integrated land restoration, provide inclusive opportunities for both men and women to contribute meaningfully to mitigation and resilience-building efforts. Central to these strategies is the equitable dissemination of accurate, accessible climate information, which is essential for fostering community-wide, proactive engagement in environmental response. This study examines gender-based disparities in climate change awareness and response knowledge across Sub-Saharan Africa, intending to advance equitable, sustainable, and locally relevant adaptation interventions.

Keywords: Gender, Structural inequalities, Socio-economic factors, Climate change adaptation, Exposure to risk, Sub-Saharan Africa

INTRODUCTION

In Sub-Saharan Africa, access to climatic information is significantly shaped by gendered sociocultural dynamics and ingrained disparities in labor, education, and decision-making authority. Despite playing a crucial role in environmental stewardship, food production, and water sourcing, rural women frequently encounter major obstacles in obtaining timely and useful climate information (Nyasimi et al., 2023). These obstacles, which lower their ability to respond to growing climate hazards, include restricted access to early warning systems, mobile technology, agricultural extension services, and formal education (Musyoki et al., 2024).

Gendered livelihood roles heavily influence how climate risks are perceived and acted upon. For instance, men involved in pastoralism often view drought as the primary threat, while women managing subsistence farms may see erratic rainfall and flooding as more immediate concerns (Perez et al., 2019). Women's experiential, place-

based knowledge, such as selecting drought-tolerant seeds, employing organic pest control, and managing soil fertility is often passed down intergenerational. However, this indigenous knowledge is frequently excluded from formal adaptation frameworks, which tend to privilege technical or male-dominated forms of expertise (Djoudi et al., 2020; IUCN, 2022). According to research, inclusive climate adaptation measures, which include women's knowledge in reforestation, land restoration, and water harvesting, result in superior ecological and social benefits (Dankelman & Alam, 2021). Nonetheless, institutional barriers persist: male-dominated extension services, discriminatory land tenure regimes, and low representation in community governance structures continue to exclude women from climate-related decision-making. These systemic prejudices prolong knowledge gaps and increase women's exposure to risk (UN Women, 2021; Agarwal, 2023).

Emerging innovations in gender-responsive climate communication are helping close these gaps. Climate education programs delivered via women's cooperatives, mobile apps, or community radio have enhanced rural women's understanding of seasonal variability, climate-smart agriculture, and resilience practices. However, such initiatives must also address gendered labor burdens and time poverty to ensure meaningful participation (FAO, 2022; Ampaire et al., 2024). Despite their substantial environmental expertise and intimate experience, rural women in Sub-Saharan Africa are mostly excluded from government conversations and decisions about climate adaptation. To solve this imbalance, climate governance must take a systemic strategy that recognizes women as crucial change agents, challenges long-standing patriarchal systems, and incorporates gender equality into adaptation planning procedures. To achieve gender-inclusive climate resilience in the region, this project will look at gender-specific elements of climate knowledge and adaptation, compare men's and women's adaptive capacity, and provide solutions for reducing institutional barriers. This study investigates the nature and implications of gender-based disparities in climate change awareness and response knowledge across Sub-Saharan Africa, with a view to advancing equitable, sustainable, and locally relevant adaptation interventions.

Conceptual Framework Overview: Gendered Knowledge Disparities and Adaptive Capacity in Sub-Saharan Africa

Figure 1 illustrates an integrative conceptual framework that maps the dynamic interplay between gendered knowledge disparities and differential adaptive capacities to climate change in Sub-Saharan Africa. The framework illustrates how climate change intersects with gender dynamics in Sub-Saharan Africa, emphasizing both the challenges and adaptive potential shaped by social, cultural, and structural (i.e., referring to institutional, legal, and cultural systems that perpetuate inequality) factors. The model delineates critical domains—including climate stressors, institutional and socio-cultural constraints, gendered access to information and resources, and levels of adaptive capacity across individual, household, and community scales. These dimensions are interlinked through reinforcing feedback loops, underscoring the systemic nature of gendered exposure to risk and the substantive potential of inclusive climate action.

At the core of the framework is the recognition that adaptive capacity is not gender-neutral; it is profoundly shaped by historically entrenched inequalities in information access, decision-making authority, and control over assets. Persistent gender-based knowledge gaps—exacerbated by lower female literacy rates, exclusion from extension services, and marginalization from formal communication networks—directly undermine women's ability to engage in anticipatory adaptation or recover from climate shocks (UN Women, 2021; IUCN, 2022).

Environmental stressors such as rising temperatures, prolonged droughts, erratic rainfall, and shifting disease ecologies place cumulative strain on ecosystems, agricultural systems, and public health. These biophysical pressures interact with socio-economic risk factors—food insecurity, water scarcity, and economic instability—thereby amplifying the urgency for gender-responsive adaptation (FAO, 2022; Musyoki et al., 2024). However, women's adaptive agency is systematically constrained by institutionalized barriers: patriarchal norms, discriminatory land tenure regimes, limited access to financial instruments, and underrepresentation in governance institutions.

The conceptual framework presented in Figure 1 offers a comprehensive lens through which to understand the gendered dimensions of climate change in Sub-Saharan Africa. At its core, the framework illustrates how climatic stressors—such as rising temperatures, erratic rainfall, and ecosystem degradation—interact with deeply rooted social structures to produce differentiated impacts on women, men, and marginalized groups. Climate

change acts as the central driver, setting off a cascade of risk factors that are mediated by social and cultural norms, institutional barriers, and unequal access to resources.

The framework conceptualizes adaptive capacity as multi-layered. At the individual level, it encompasses awareness, agency, and experiential learning; at the household level, it involves intra-household power relations, labor division, and livelihood diversification; and at the community level, it reflects collective action, social capital, and participatory governance. Each layer is susceptible to gender-specific constraints that must be addressed through targeted interventions (Dankelman & Alam, 2021; Djoudi et al., 2020).

Importantly, the framework highlights the role of feedback loops in reinforcing or disrupting gendered adaptation pathways. Gender-responsive climate strategies—such as equitable access to land, training in climate-smart technologies, inclusive communication platforms, and leadership opportunities for women—can catalyze substantive shifts in norms and policies. These strategies generate upward feedback that not only enhances resilience but also informs more equitable policy design and implementation.

Ultimately, the framework posits that addressing gendered disparities in climate knowledge and adaptive capacity is central to achieving sustainable, inclusive, and locally grounded resilience. It calls for integrated adaptation approaches that embed gender equity as both a means and an end, ensuring that climate responses are as socially just as they are ecologically sound (Ampaire et al., 2024; Nyasimi et al., 2023).

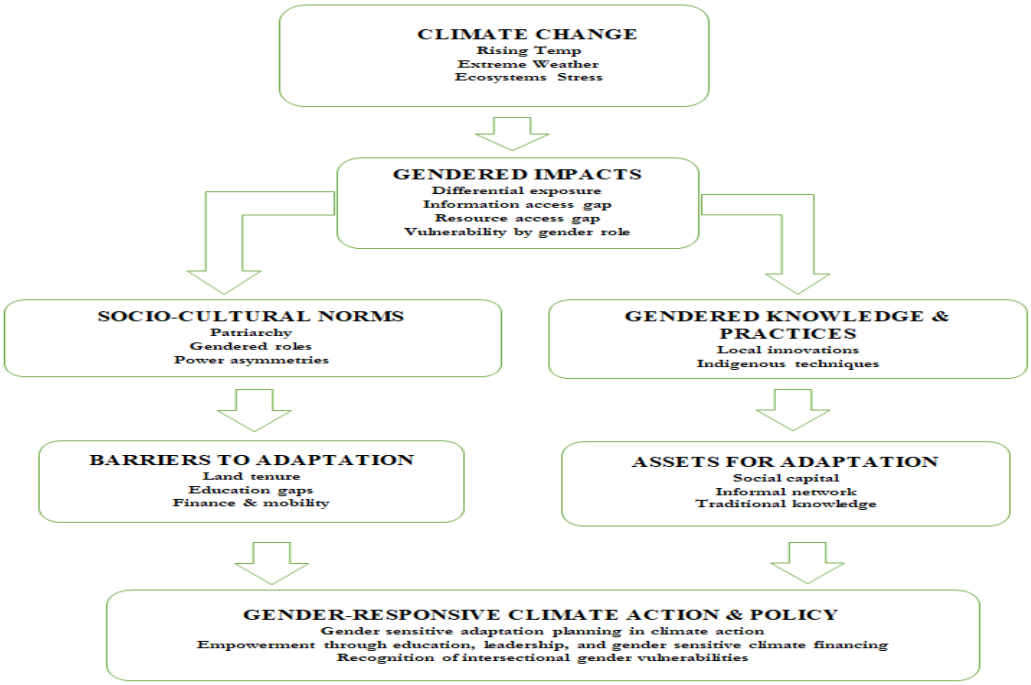

Figure 1. Conceptual Framework Overview for Gendered Perspectives on Climate Change in Sub-Saharan Africa

Adaptive capacity operates at multiple, interdependent levels. At the individual scale, cognitive awareness, agency, and experiential knowledge inform proactive climate action. Within households, power dynamics, labor allocation, and livelihood diversification shape the ability to manage risk. At the community level, collective action, access to social capital, and participation in local governance are critical enablers of resilience. By recognizing and addressing the gendered determinants that shape each of these levels, policymakers can build more inclusive and contextually relevant adaptation frameworks that promote long-term sustainability and social equity (Dankelman & Alam, 2021; Djoudi et al., 2020).

Gender-responsive climate action demands a comprehensive, intersectional (i.e., recognizing how overlapping identities such as gender, age, ethnicity, and socio-economic status compound vulnerability) framework that embeds gender equity at the heart of climate governance. This entails institutional gender sensitization, the mainstreaming of gender perspectives across policy and programmatic cycles, and the systematic collection and

application of sex-disaggregated data in planning, monitoring, and evaluation. Integral to this approach is the co-creation of inclusive climate communication strategies that elevate marginalized voices—particularly those of women, girls, and indigenous communities—and ensure their active participation in shaping adaptation and mitigation responses (UNFCCC, 2019; Vincent et al., 2017; UN Women, 2021).

Embedding gender analysis within climate interventions facilitates a nuanced understanding of differentiated risk factors, capacities, and coping mechanisms. This allows for the design of targeted and equitable adaptation frameworks that align with the lived realities of both women and men. Such integration not only improves the legitimacy and efficacy of climate responses but also contributes to social cohesion, builds adaptive capacity, and nurtures inclusive systems of environmental governance (Rao et al., 2017; Perez et al., 2019; Nyasimi et al., 2023). When women are recognized as critical knowledge holders and decision-makers—rather than passive recipients of aid—climate initiatives are more likely to succeed and generate sustainable, equitable outcomes (Agrawal et al., 2019; Ampaire et al., 2024).

The framework contrasts the barriers to adaptation with adaptive assets, showcasing the dual reality many communities face. While limited access to formal resources remains a significant constraint, social capital, mutual support systems, and experiential knowledge serve as powerful adaptive tools that can be leveraged through inclusive and gender-sensitive programming. This duality points to the necessity of designing interventions that address structural (i.e., referring to institutional, legal, and cultural systems that perpetuate inequality) barriers while also harnessing existing strengths within communities.

Gender-inclusive climate strategies function through adaptive feedback loops that catalyze substantive change over time. As women gain improved access to climate information, financial services, land rights, training, and leadership spaces, their agency and adaptive capacities are enhanced. This empowerment fosters resilience at both household and community levels and gradually challenges patriarchal structures, enabling broader gender-equitable participation across agricultural, environmental, and political domains (Djoudi et al., 2020; Dankelman & Alam, 2021; IUCN, 2022).

Furthermore, the iterative successes of gender-integrated models provide valuable evidence to refine future interventions. When learning is embedded in climate governance, these feedback mechanisms become self-reinforcing, elevating both gender equality and climate resilience synergistically. Such substantive approaches bridge the technical and social dimensions of adaptation, ensuring climate action is not only scientifically robust but also inclusive, just, and sustainable (Brody et al., 2015; Terry, 2017; Musyoki et al., 2024).

The Role of Gender in Shaping Climate Change Adaptation and Resilience in Local Communities

For instance, in Kenya, research by Ampaire et al. (2024) showed that women reported less access to seasonal climate forecasts than men, primarily due to lower mobile phone ownership and literacy levels. In Zimbabwe, Nhamo & Nhamo (2016) observed that men were more aware of drought-resistant maize varieties due to greater participation in farmer field schools, while women relied more on indigenous practices such as mulching and early planting. Meanwhile, in Mali, Carr & Owusu-Daaku (2016) found women were often excluded from NGO-led adaptation training sessions because of gendered household responsibilities, further entrenching the information gap.

Gender-specific norms, roles, and responsibilities significantly shape how individuals and communities experience climate exposure to risk and respond to environmental stressors; understanding and integrating these dynamics is critical for designing inclusive, effective, and sustainable climate adaptation and resilience strategies at the local level. Men's and women's adaptation priorities are deeply shaped by prevailing social norms, culturally defined roles, and institutional responsibilities. These elements either reinforce or undermine gender equity within climate change adaptation strategies (Nellemann et al., 2011). Gender-specific differences in adaptation preferences are observable across communities due to variations in sociocultural expectations and labor divisions. Adaptation strategies that fail to consider these differences risk distorting existing roles or exacerbating inequalities rather than promoting resilience.

In many rural African contexts, women predominantly shoulder the responsibility for securing household nutrition, managing water procurement, and tending small livestock—tasks that become increasingly precarious amid escalating droughts and climate variability (Meinzen-Dick et al., 2019; Quilca et al., 2021). Men, conversely, are more frequently involved in land cultivation, resource extraction, and market engagement, which expose them to distinct climate-related risks and adaptive challenges (Pearse, 2020; Arora-Jonsson, 2017). These entrenched gendered roles and power asymmetries influence exposure to hazards and critically mediate access to crucial adaptation assets, including climate information, technological innovations, and financial instruments (Djoudi et al., 2016; van Aelst & Holvoet, 2016; Brody et al., 2017). Table 1 below synthesizes comparative examples from additional Sub-Saharan African countries, highlighting how gendered roles shape access to climate adaptation knowledge and institutional support.

Table 1: Gendered Knowledge Gaps in Climate Adaptation across Selected Sub-Saharan African Countries

Country	Gendered Roles	Knowledge Gaps	Source
Kenya	Men access weather apps; women manage household-level food security	Women lack access to mobile-based forecasts and agricultural extension	Ampaire et al. (2024)
Zimbabwe	Men focus on field crops; women on indigenous food and soil management	Women underrepresented in formal farmer training programs	Nhamo & Nhamo (2016)
Mali	Men participate in NGO trainings; women tied to domestic responsibilities	Exclusion of women from adaptation planning forums	Carr & Owusu-Daaku (2016)
Ethiopia	Men dominate land ownership and marketing; women engage in home gardening	Limited land rights and credit access for women	Perez et al. (2019)
Uganda	Women manage food preparation and the collection of water/firewood	Restricted mobility limits access to training and tools	Rao et al. (2017)
Nigeria	Men participate in irrigation schemes; women grow subsistence crops	Low representation of women in local water committees	FAO (2022)

Cultural norms strongly influence the types of responsibilities men and women assume about natural resource management and climate mitigation efforts. Although the specifics vary across settings, there are broader adherence patterns that emerge. For instance, women are generally more involved in household food production, processing, and preparation, while men tend to dominate market-oriented agricultural activities (Meinzen-Dick et al., 2010). Moreover, the distribution of food, nutrients, and caloric intake within households often follows gendered lines, reflecting embedded social hierarchies.

Viewing climate change through a gender lens reveals how essential it is to consider the differentiated roles, access, and constraints faced by women. Effective mitigation and adaptation efforts should not only acknowledge these realities but also work toward redressing underlying gender inequities. Unfortunately, glaring disparities in access to climate-related knowledge—rooted in broader institutional, cultural, and social barriers—undermine women's capacity to engage fully in adaptation processes. These disparities often translate into low participation rates among women and missed opportunities for inclusive and locally informed interventions.

Despite the central role women play in local environmental stewardship, climate change programs in Sub-Saharan Africa frequently overlook their contributions. One of the key reasons adaptation interventions falter is the failure of planners and implementers to appreciate the gender-specific distribution of knowledge, roles, and capacities. Ignoring these differences not only undermines the effectiveness of such interventions but also risks alienating key stakeholders and reinforcing systemic exclusion.

Empowering women through inclusive policies, education, and capacity-building initiatives is imperative. National governments and local institutions must recognize and support the agency of women by dismantling discriminatory barriers, especially those related to land tenure, property rights, and access to productive resources. Ensuring equal land and inheritance rights, for example, can significantly improve women's adaptive capacities and long-term resilience to climate shocks.

Addressing these challenges also requires dismantling dominant, often gender-blind discourses that shape climate policy and practice. As MacGregor (2010) contends, it is vital to "dig down and pull up the deep roots of the discourses that frame gender and climate politics." A substantive approach to climate governance must confront embedded power structures and reframe gender not as a peripheral concern but as central to sustainability. Moreover, intersectional (i.e., recognizing how overlapping identities such as gender, age, ethnicity, and socio-economic status compound vulnerability) dimensions such as age, ethnicity, and socioeconomic status intricately intertwine with gender, intensifying risk factors or conferring adaptive capacities. This complexity highlights the multifaceted nature of climate resilience within diverse rural communities (Crenshaw, 1991; Nightingale, 2011; Resurrección, 2013). Consequently, a sophisticated and deliberate incorporation of gender dynamics is essential to devise climate adaptation strategies that are not only efficacious but also socially equitable—empowering marginalized populations and enhancing resilience across the broader socio-ecological landscape (Doss, 2018; Enarson & Fordham, 2020; Djoudi et al., 2016; Dankelman, 2010).

Additionally, gendered behavioral distinctions emerge in responses to climate risk. Women's generally higher risk aversion often positions them advantageously in adaptation processes, as they tend to be more proactive in seeking guidance, responding to warnings, and assimilating lessons from prior climatic events (Patt et al., 2009). This predisposition frequently leads women to preferentially adopt ex-post collective risk management strategies—such as weather-index insurance schemes—where anticipation and social solidarity are pivotal. In essence, embedding gender-specific perspectives within climate adaptation frameworks is not only a matter of justice but also a strategic imperative. Appreciating the differentiated roles, experiential knowledge, and risk perceptions across genders unlocks pathways toward more effective, inclusive, and enduring climate resilience solutions in Sub-Saharan Africa. Empirical evidence underscores the need for such a shift. Research in South Africa by Thomas et al. (2007) found that gendered livelihood roles shape climate risk perceptions: men, primarily responsible for livestock, prioritized drought, while women, more engaged in crop production, prioritized heavy rainfall. This suggests not only a divergence in perceived climate risks but also in the values attached to those risks, highlighting the necessity of gender-differentiated adaptation planning (Gustafson, 1998).

Gendered Indigenous Knowledge for Climate Resilience

Indigenous knowledge systems, shaped over generations through lived experience and cultural continuity, are central to local adaptation strategies in Sub-Saharan Africa. However, these knowledge systems are not uniformly held or transmitted; they are profoundly gendered, reflecting distinct roles, responsibilities, and power relations assigned to men and women within agrarian and pastoral societies. These differentiated roles shape the types of ecological knowledge individuals possess, the adaptation practices they prioritize, and the constraints they face in responding to climate risks (Nellemann et al., 2011; Kaijser & Kronsell, 2014).

Men and women often hold specialized, context-specific knowledge derived from their gendered labor patterns. Women, for example, are typically more involved in household-level food production, seed selection, soil fertility management, and the collection of water and fuelwood. This positions them as key custodians of biodiversity and food security, especially in climate-sensitive sectors (Dankelman, 2010; Kristjanson et al., 2017). Conversely, men are more frequently engaged in market-oriented farming, resource extraction, and infrastructure maintenance—roles that generate different environmental exposures and adaptive insights (Meinzen-Dick et al., 2010; Arora-Jonsson, 2017).

Despite their indispensable contributions to environmental management, women's indigenous knowledge is routinely marginalized in formal climate policy, planning, and programming. Mainstream adaptation initiatives often privilege technocratic, male-dominated knowledge systems, overlooking the embedded, place-based

expertise that women possess (Djoudi et al., 2016; Westermann et al., 2018). This exclusion not only limits the efficacy of climate interventions but also perpetuates broader gender inequalities.

Cultural norms also shape household dynamics and access to critical adaptation resources, such as land, livestock, and agricultural inputs. Gendered hierarchies within households influence decision-making authority, access to income, and prioritization of adaptation measures. Intra-household food distribution often follows gendered lines, with men and boys prioritized during periods of scarcity, further reinforcing women's exposure to risk (Kevany & Huong, 2013; Sraboni et al., 2014).

Empowering women to act on their knowledge requires the dismantling of institutional and socio-cultural barriers. Policies that guarantee equal land and inheritance rights, promote gender-sensitive agricultural extension, and facilitate women's access to credit and information technologies are critical levers for enhancing adaptive capacity (Alston, 2014; Huyer et al., 2016). Such interventions must be complemented by inclusive participatory approaches that elevate women's voices in planning, monitoring, and evaluating adaptation programs.

Empirical evidence reinforces the need for gender-responsive approaches. A South African study by Thomas et al. (2007) demonstrated that women—responsible for crop production—were more concerned with heavy rainfall and soil erosion, while men—focused on livestock—prioritized drought preparedness. This divergence in risk perception underscores the necessity of integrating gender-differentiated experiences into adaptation planning (Gustafson, 1998).

Furthermore, behavioral differences in risk response have important implications for resilience strategies. Women's higher levels of risk aversion often make them more proactive in seeking information, adopting collective adaptation strategies, and learning from past climatic events (Patt et al., 2009). Their engagement in community-based risk reduction initiatives, such as seed banks and savings groups, enhances communal resilience and knowledge-sharing.

In sum, the integration of gendered indigenous knowledge into formal climate responses is both a moral imperative and a strategic necessity. By recognizing women not merely as beneficiaries but as active knowledge holders and agents of change, climate interventions can become more inclusive, effective, and contextually grounded. A shift toward co-produced, gender-equitable adaptation strategies is essential for fostering sustainable and socially just climate resilience in Sub-Saharan Africa.

Climate Change and Gendered Knowledge Inequities: Toward Inclusive and Equitable Adaptation Pathways

Climate change poses complex, interconnected threats to livelihoods, public health, food systems, and ecosystem integrity—impacts that are mediated by gendered social structures and knowledge systems. In Sub-Saharan Africa, women are disproportionately affected by climate-induced stressors due to their dependence on climate-sensitive natural resources, coupled with persistent structural (i.e., referring to institutional, legal, and cultural systems that perpetuate inequality) inequalities that limit their access to information, decision-making platforms, and adaptive resources (UN Women, 2018; Djoudi et al., 2016).

Despite increased global discourse on climate justice, significant knowledge asymmetries persist—particularly among rural, marginalized, and low-literacy populations. These disparities are reinforced by infrastructural barriers, gendered labor burdens, and exclusionary sociocultural norms that hinder women's access to early warning systems, climate forecasts, and extension services (Vincent et al., 2017; Tall et al., 2014). Consequently, women are often unable to anticipate or mitigate climate risks effectively, rendering them more at risk to shocks such as droughts, floods, and disease outbreaks (Carr & Owusu-Daaku, 2016; Brody et al., 2015).

Bridging these gendered knowledge gaps necessitates substantive communication strategies that integrate indigenous wisdom with scientific data, while also recognizing the socio-cultural contexts in which women operate. This includes designing gender-sensitive educational initiatives, digital literacy programs, and participatory platforms that enhance women's capacity to process, interpret, and apply climate information. Such

interventions must also account for time poverty, restricted mobility, and limited access to digital infrastructure, all of which disproportionately affect women's engagement in formal knowledge systems (Gonda, 2019; Arora-Jonsson, 2011).

The marginalization of women from climate governance structures—both formal and informal—undermines their agency and silences vital experiential insights. Although women frequently assume primary roles in food provisioning and ecosystem management, their contributions are rarely acknowledged in climate planning processes. Legal and institutional reforms, particularly those that secure land tenure, inheritance rights, and access to credit and technology, are fundamental to reversing this exclusion (FAO, 2018; Meinzen-Dick et al., 2019).

Importantly, gendered exposure to risk must not be reduced to material deprivation alone. It also arises from power differentials within knowledge systems—who generates knowledge, whose expertise is legitimized, and who is heard in policymaking arenas. Women's adaptive strategies—such as crop diversification, water harvesting, and sustainable soil management—are often grounded in generations of localized knowledge, yet they are rarely codified or institutionalized in mainstream climate responses (Goh, 2012; Dankelman, 2016).

Advancing inclusive adaptation requires a co-production of knowledge between scientists, policymakers, and local communities. This co-production must center women's voices, not as peripheral participants but as pivotal actors in shaping context-appropriate solutions (Agarwal, 2015; Carr et al., 2017). substantive adaptation also involves gender mainstreaming across public institutions, expansion of women-led extension services, and the institutionalization of gender-disaggregated data to guide planning, monitoring, and evaluation efforts.

Evidence demonstrates that female-led communication channels—whether through peer networks, cooperatives, or community media—are more effective in reaching and empowering rural women with actionable climate knowledge (Poats, 1991; Tall et al., 2014). Therefore, dismantling male-dominated information hierarchies and fostering inclusive communication ecosystems are critical to enabling climate-resilient communities.

In essence, closing the gendered climate knowledge gap is not only an ethical imperative but a strategic pathway to resilience. Unless adaptation policies explicitly address structural (i.e., referring to institutional, legal, and cultural systems that perpetuate inequality) barriers to information, participation, and resource access, climate action will remain inequitable and ultimately ineffective in safeguarding the most at risk.

Implications

The gendered dimensions of climate exposure to risk and adaptive capacity in Sub-Saharan Africa underscore the urgent need for a paradigmatic shift in climate governance. Gender must be treated not as a peripheral consideration, but as a foundational determinant of how individuals and communities experience, interpret, and respond to environmental change. The empirical evidence reveals that men and women are impacted differently by climate stressors due to systemic inequalities in access to land, information, decision-making authority, and socio-economic opportunity.

A central implication of this study is the necessity of addressing gender-based disparities in climate knowledge and access through intentional, targeted investment in climate literacy, inclusive communication platforms, and community-based learning mechanisms. Without equitable access to relevant and actionable climate information, women's capacity to engage in effective adaptation remains severely constrained. Moreover, adaptation programs that fail to recognize and incorporate women's experiential and indigenous knowledge risk missing critical insights that can enhance sustainability and ecological resilience.

For adaptation initiatives to be substantive rather than tokenistic, gender sensitivity must be embedded at every stage of the climate policy cycle—from design and budgeting to implementation and monitoring. This includes concrete actions such as reforming land tenure policies to ensure women's ownership rights, expanding women-led extension services, implementing gender-responsive budgeting, and institutionalizing mechanisms for women's participation in climate governance at all levels.

Furthermore, adaptation strategies are demonstrably more effective when they are locally grounded and socially inclusive. Evidence shows that practices such as agroecology, conservation agriculture, and participatory land restoration yield greater ecological and social returns when they center women's voices and dismantle the barriers to their meaningful participation.

At the institutional level, genuine transformation requires confronting and dismantling the patriarchal norms that continue to marginalize women from formal decision-making spaces. Building women's leadership capacity in climate governance, supporting equitable representation, and ensuring gender parity in key institutions are essential steps toward reconfiguring climate governance to be more just, effective, and durable.

In sum, closing the gender gap in climate adaptation is not merely a matter of justice—it is a strategic imperative for building robust, context-sensitive, and sustainable responses to the climate crisis. Achieving this requires multi-level commitment, from grassroots organizations to national and regional institutions, and a willingness to redesign adaptation frameworks that prioritize gender equity as both a guiding principle and a measurable outcome.

CONCLUSION

This study highlights the enduring and systemic gender disparities that shape climate exposure to risk, knowledge dissemination, and adaptive responses across Sub-Saharan Africa. These inequalities—rooted in patriarchal norms, institutional exclusion, and socio-economic marginalization—undermine the efficacy and equity of current climate adaptation efforts. Women, particularly in rural settings, face disproportionate exposure to climate-related risks while simultaneously being excluded from the information systems, decision-making platforms, and resource channels necessary for effective adaptation.

Addressing these intersecting challenges requires more than isolated policy fixes. It demands a comprehensive, intersectional (i.e., recognizing how overlapping identities such as gender, age, ethnicity, and socio-economic status compound vulnerability), and gender-substantive approach that reimagines climate governance. Gender equity must be institutionalized through legal reform, inclusive policy frameworks, and structural (i.e., referring to institutional, legal, and cultural systems that perpetuate inequality) adjustments that facilitate equal access to land, credit, education, and leadership opportunities. A meaningful transformation also hinges on the systematic integration of women's indigenous knowledge and lived experiences into adaptation and mitigation strategies—moving beyond token participation to co-creation of solutions.

Equally critical is the reconfiguration of climate communication channels. These must be context-specific, linguistically accessible, and responsive to the unique needs of low-literacy and marginalized populations. Community-based platforms, peer learning networks, and ICT tools tailored to gender-specific constraints can enhance the reach and relevance of climate information. Such inclusive systems foster anticipatory action, strengthen adaptive capacity, and democratize resilience-building processes.

Ultimately, embedding gender perspectives into climate strategies is not merely an ethical imperative; it is a strategic necessity for achieving sustainable and inclusive adaptation. When women are empowered as agents of change—rather than positioned as passive recipients of interventions—communities are better equipped to navigate ecological shocks, safeguard food and water systems, and foster intergenerational resilience. Realizing gender-equitable climate resilience in Sub-Saharan Africa requires deliberate, coordinated action across policy, practice, and research spheres. It calls for unwavering commitment from governments, development partners, civil society, and local actors to ensure that no one is left behind in the face of escalating climate risks.

Key Highlights

- Gender remains a significant factor in determining climate exposure to risk and adaptive capacity among diverse populations.
- Structural (i.e., referring to institutional, legal, and cultural systems that perpetuate inequality) inequalities hinder women's access to knowledge, resources, and leadership in climate governance.

- Localized adaptation practices, when inclusive, enhance resilience and environmental sustainability.
- The reduction of the climate knowledge gap necessitates the implementation of equitable communication strategies and capacity building.
- The four-pillar approach, including capacity, governance, accessibility, and co-production, is crucial for implementing substantive, gender-responsive adaptation strategies.
- Gender inclusion in climate policy is crucial for ensuring equity, efficacy, and sustainability.

REFERENCES

1. Agarwal, B. (2015). Food security, productivity, and gender inequality. Journal of Peasant Studies, 42(1), 1–23. https://doi.org/10.1080/03066150.2014.936007
2. Agarwal, B. (2023). Gender, environment and climate change: Revisiting institutions, ideologies and inequality. Oxford University Press.
3. Agrawal, A., McSweeney, C., & Perrin, N. (2019). Social dimensions of climate change: Equity and exposure to risk in a warming world. World Bank Publications. https://doi.org/10.1596/978-0-8213-7887-8
4. Alston, M. (2014). Gender mainstreaming and climate change. Women's Studies International Forum, 47, 287-294.
5. Ampaire, E. L., Acosta, M., Huyer, S., Kigonya, R., Muchunguzi, P., Muna, R., ... & Jassogne, L. (2017). Gender in climate change adaptation and agriculture: A review of the evidence. Agriculture for Development, 30, 16-23.
6. Ampaire, E. L., Twyman, J., Jassogne, L., & Bonilla-Findji, O. (2024). Enhancing women's access to climate knowledge through ICT-based extension in East Africa. Climate Services, 33, 100407. https://doi.org/10.1016/j.cliser.2024.100407
7. Arora-Jonsson, S. (2017). "Virtue and exposure to risk: Discourses on women, gender and climate change." Global Environmental Change, 47, 1–12. https://doi.org/10.1016/j.gloenvcha.2017.08.004
8. Brody, A., Demetriades, J., & Esplen, E. (2017). Gender and climate change: Mapping the linkages. Social Development Papers, Paper No. 127. World Bank.
9. Carr, E. R., & Owusu-Daaku, K. N. (2016). The shifting epistemologies of exposure to risk in climate services for development: The case of Mali. Area, 48(1), 7–17. https://doi.org/10.1111/area.12179
10. Carr, E. R., Fleming, G., & Kalala, T. (2017). Understanding women's exposure to risk in climate change adaptation programs: The role of subjectivity in political economy. Climate and Development, 9(4), 297–309. https://doi.org/10.1080/17565529.2016.1145097
11. Crenshaw, K. (1991). Mapping the margins: Intersectionality, identity politics, and violence against women of color. Stanford Law Review, 43(6), 1241–1299. https://doi.org/10.2307/1229039
12. Dankelman, I. (2010). Gender and climate change: An introduction. Routledge.
13. Dankelman, I. (2016). Gender and climate change: An introduction. Earthscan/Routledge.
14. Dankelman, I., & Alam, M. (2021). Gender and climate change: An introduction (2nd ed.). Routledge. https://doi.org/10.4324/9781003080517
15. Djoudi, H., Locatelli, B., Vaast, C., Asher, K., & Brockhaus, M. (2020). Gender equality in climate policy and practice hindered by assumptions. Nature Climate Change, 10(9), 769–772. https://doi.org/10.1038/s41558-020-0831-3
16. Djoudi, H., Locatelli, B., Vaast, C., Asher, K., Brockhaus, M., & Sijapati, B. (2016). Beyond dichotomies: Gender and intersecting inequalities in climate change studies. Ambio, 45(3), 248–262. https://doi.org/10.1007/s13280-016-0825-2
17. Doss, C. (2018). Women and Agricultural Productivity: Reframing the Issues. Development Policy Review, 36(1), 35–50. https://doi.org/10.1111/dpr.12243
18. Enarson, E., & Fordham, M. (2020). Gender and climate change: Impact and adaptation. In M. Leichenko & K. O'Brien (Eds.), The Oxford Handbook of Climate Change and Society (pp. 295–308). Oxford University Press.
19. FAO. (2018). The role of women in agriculture. Food and Agriculture Organization.

20. FAO. (2021). The state of food and agriculture 2021: Making agrifood systems more resilient to shocks and stresses. https://doi.org/10.4060/cb4476en
21. FAO. (2022). Gendered impacts of climate change in Africa: Policy priorities for adaptation and mitigation. Food and Agriculture Organization of the United Nations.
22. Goh, A. H. X. (2012). A literature review of the gender-differentiated impacts of climate change on women's and men's assets and well-being in developing countries. IFPRI Discussion Paper 01113. https://doi.org/10.2499/9780896298460_01
23. Gonda, N. (2019). Re-politicizing exposure to risk and adaptation: Towards substantive gender and climate change adaptation research. International Feminist Journal of Politics, 21(1), 86–100. https://doi.org/10.1080/14616742.2018.1452569
24. Huyer, S., Twyman, J., Koningstein, M., Ashby, J., & Vermeulen, S. (2016). Supporting women's roles in climate change adaptation and mitigation. CCAFS Info Note.
25. IUCN. (2022). Gender and climate change: A closer look at existing evidence and data gaps. International Union for Conservation of Nature. https://genderandenvironment.org/resource/gender-and-climate-change-2022/
26. Kaijser, A., & Kronsell, A. (2014). Climate change through the lens of intersectionality. Environmental Politics, 23(3), 417-433.
27. Kevany, K., & Huong, D. T. T. (2013). Exploring the role of women in household food security in rural Vietnam. Food Security, 5(5), 655-667.
28. Kristjanson, P., Bryan, E., Bernier, Q., Twyman, J., Meinzen-Dick, R., Kieran, C., ... & Doss, C. (2017). Addressing gender in agricultural research and development: Lessons learned and guidelines for future work. CCAFS Working Paper.
29. Meinzen-Dick, R., Quisumbing, A. R., Behrman, J. A., Biermayr-Jenzano, P., Wilde, V., Noordeloos, M., ... & Beintema, N. (2010). Engaging men and women in agricultural development: Closing the gender gap in agriculture and rural development. IFPRI.
30. Meinzen-Dick, R., Quisumbing, A., Behrman, J., Biermayr-Jenzano, P., Wilde, V., Noordeloos, M., Ragasa, C., & Beintema, N. (2019). Engendering agricultural research, development, and extension. International Food Policy Research Institute. https://doi.org/10.2499/9780896292635
31. Musyoki, J., Muthee, A., & Okonjo, J. (2024). Strengthening gender-responsive climate adaptation in sub-Saharan Africa: Policy and programmatic priorities. African Journal of Climate Policy and Development, 6(1), 23–40. https://doi.org/10.4314/ajcpd.v6i1.3
32. Nellemann, C., Verma, R., & Hislop, L. (Eds.). (2011). Women at the frontline of climate change: Gender risks and hopes. UNEP. https://www.unep.org/resources/report/women-frontline-climate-change
33. Nhamo, G., & Nhamo, S. (2016). Gender, climate change and food security: A case study of the role of women in climate adaptation in Zimbabwe. Journal of Human Ecology, 53(2), 180–186.
34. Nightingale, A. J. (2011). Bounding difference: Intersectionality and the material production of gender, caste, class and environment in Nepal. Geoforum, 42(2), 153–162. https://doi.org/10.1016/j.geoforum.2010.09.006
35. Nyasimi, M., Amwata, D., Hove, L., Kinyangi, J., & Wamukoya, G. (2014). Evidence of impact: Climate-smart agriculture in Africa. CCAFS Working Paper No. 86. https://hdl.handle.net/10568/51391
36. Nyasimi, M., Mwongera, C., & Thornton, P. (2023). Gendered climate resilience: substantive strategies for inclusive adaptation in African smallholder systems. Climate and Development, 15(2), 145–158. https://doi.org/10.1080/17565529.2022.2094135
37. Pearse, R. (2020). Gender and climate change. Routledge.
38. Perez, C., Jones, E., Kristjanson, P., Cramer, L., Thornton, P. K., & Förch, W. (2019). How resilient are farming households, and who is at risk? A gendered assessment of resilience in Ethiopia, Kenya, Uganda and Tanzania. Climate and Development, 11(5), 472–488. https://doi.org/10.1080/17565529.2018.1442796
39. Poats, S. V. (1991). The role of gender in agricultural development. In M. C. Hall, A. L. Ferleger, & D. L. Fetter (Eds.), Agricultural sustainability: Environmental and statistical considerations (pp. 213–225). Westview Press.
40. Quilca, G., Caron, P., & Frías, C. (2021). Women's role in sustainable smallholder livestock farming and climate resilience in Peru. Climate and Development, 13(7), 630–642. https://doi.org/10.1080/17565529.2020.1774387

41. Rao, N., Lawson, E. T., Raditloaneng, W. N., Solomon, D., & Angula, M. N. (2017). Gendered risk factors to climate change: Insights from the semi-arid regions of Africa and Asia. Climate and Development, 11(1), 14–26. https://doi.org/10.1080/17565529.2017.1372266
42. Resurrección, B. P. (2013). Persistent women and environment linkages in climate change and sustainable development agendas. Gender & Development, 21(2), 283–297. https://doi.org/10.1080/13552074.2013.802606
43. Smit, B., & Pilifosova, O. (2001). Adaptation to climate change in the context of sustainable development and equity. In J. J. McCarthy et al. (Eds.), Climate change 2001: Impacts, adaptation, and exposure to risk (pp. 877–912). Cambridge University Press.
44. Sraboni, E., Quisumbing, A. R., & Ahmed, A. U. (2014). How empowering women can improve agriculture and food security in Bangladesh. IFPRI.
45. Tall, A., Kristjanson, P., Chaudhury, M., McKune, S., & Zougmore, R. (2014). Who gets the information? Gender, power and equity considerations in the design of climate services for farmers. CGIAR CCAFS Working Paper No. 89. https://hdl.handle.net/10568/49673
46. Terry, G. (2017). Climate change and gender justice. Practical Action Publishing. https://doi.org/10.3362/9781780448796
47. UN Women. (2018). Turning promises into action: Gender equality in the 2030 Agenda for Sustainable Development. https://www.unwomen.org/en/digital-library/publications/2018/2/gender-equality-in-the-2030-agenda-for-sustainable-development-2018
48. UN Women. (2021). The gender–climate nexus: Gender equality and women's empowerment in climate policy and action.
49. UN Women. (2022). Gender equality in climate action: Progress and challenges. https://www.unwomen.org/en/digital-library/publications
50. UNFCCC. (2019). The Gender Action Plan under the UNFCCC. United Nations Framework Convention on Climate Change. https://unfccc.int/gender
51. UNFCCC. (2023). Climate change and gender. United Nations Framework Convention on Climate Change. https://unfccc.int/topics/gender/the-big-picture/introduction
52. van Aelst, K., & Holvoet, N. (2016). Mainstreaming gender in climate change adaptation policies and practices: A literature review. Environmental Science & Policy, 66, 19–25. https://doi.org/10.1016/j.envsci.2016.09.006
53. Vincent, K., Tschakert, P., Barnett, J., & Rivera-Ferre, M. (2017). Addressing gender in climate risk and exposure to risk assessments. Wiley Interdisciplinary Reviews: Climate Change, 8(2), e462. .
54. Westermann, O., Thornton, P., & Förch, G. (2018). Gender and social considerations in climate-smart agriculture: Insights from six African countries. CCAFS Working Paper.